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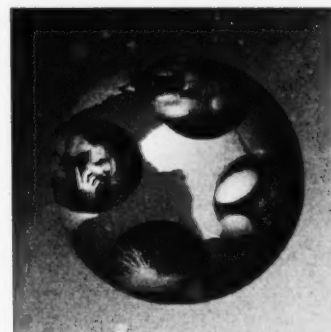
Science, Innovation and Electronic Information Division

Report on Interviews on the Commercialization of Innovation

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- .. not available for a specific reference period
- ... not applicable
- 0 true zero or a value rounded to zero
- 0^s value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
- ^p preliminary
- ^r revised
- x suppressed to meet the confidentiality requirements of the *Statistics Act*
- ^E use with caution
- F too unreliable to be published

Note

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Note of appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

The science and innovation information program

The purpose of this program is to develop useful indicators of science and technology activity in Canada based on a framework that ties them together into a coherent picture. To achieve the purpose, statistical indicators are being developed in five key entities:

- **Actors:** are persons and institutions engaged in S&T activities. Measures include distinguishing R&D performers, identifying universities that license their technologies, and determining the field of study of graduates.
- **Activities:** include the creation, transmission or use of S&T knowledge including research and development, innovation, and use of technologies.
- **Linkages:** are the means by which S&T knowledge is transferred among actors. Measures include the flow of graduates to industries, the licensing of a university's technology to a company, co-authorship of scientific papers, the source of ideas for innovation in industry.
- **Outcomes:** are the medium-term consequences of activities. An outcome of an innovation in a firm may be more highly skilled jobs. An outcome of a firm adopting a new technology may be a greater market share for that firm.
- **Impacts:** are the longer-term consequences of activities, linkages and outcomes. Wireless telephony is the result of many activities, linkages and outcomes. It has wide-ranging economic and social impacts such as increased connectedness.

The development of these indicators and their further elaboration is being done at Statistics Canada, in collaboration with other government departments and agencies, and a network of contractors.

Prior to the start of this work, the ongoing measurements of S&T activities were limited to the investment of money and human resources in research and development (R&D). For governments, there were also measures of related scientific activity (RSA) such as surveys and routine testing. These measures presented a limited picture of science and technology in Canada. More measures were needed to improve the picture.

Innovation makes firms competitive and we are continuing with our efforts to understand the characteristics of innovative and non-innovative firms, especially in the service sector that dominates the Canadian Economy. The capacity to innovate resides in people and measures are being developed of the characteristics of people in those industries that lead science and technology activity. In these same industries, measures are being made of the creation and the loss of jobs as part of understanding the impact of technological change.

The federal government is a principal player in science and technology in which it invests over five billion dollars each year. In the past, it has been possible to say only *how much* the federal government spends and *where* it spends it. Our report *Federal Scientific Activities, 1998* (Cat. no. 88-204) first published socio-economic objectives indicators to show *what* the S&T money is spent on. As well as offering a basis for a public debate on the priorities of government spending, all of this information has been used to provide a context for performance reports of individual departments and agencies.

As of April 1999, the Program has been established as a part of Statistics Canada's Science, Innovation and Electronic Information Division.

The final version of the framework that guides the future elaboration of indicators was published in December, 1998 (*Science and Technology Activities and Impacts: A Framework for a Statistical Information System*, Cat. no. 88-522). The framework has given rise to *A Five-Year Strategic Plan for the Development of an Information System for Science and Technology* (Cat. no. 88-523).

It is now possible to report on the Canadian system on science and technology and show the role of the federal government in that system.

Our working papers and research papers are available at no cost on the Statistics Canada Internet site at <http://www.statcan.ca/cgi-bin/downpub/research.cgi?subject=193>.

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The opinions expressed in this report are those of the authors and are not necessarily those of Statistics Canada.

Table of contents

1.	Introduction	7
2.	Background of project	8
3.	Concept, definitions and models for commercialization in science and technology	9
3.1	Definitions	9
3.1.1	Commercialization as defined by the Canadian panel of experts on commercialization.....	9
3.1.2	Commercialization as defined by the Department of Fisheries and Oceans Canada	9
3.1.3	Commercialization of innovations as defined by the Oslo Manual (2005)	9
3.2	Models	10
3.2.1	Chronological and linear approach	10
3.2.1.1	Model of H. Randall Goldsmith	10
3.2.1.2	Commercialization model of James Andrew and Andrew Sirkin	11
3.2.1.3	The technological innovation and commercialization model of Rothwell and Zegveld	12
3.2.2	Functional approach	12
4.	Other concepts and themes related to commercialization in science and technology	14
4.1	Transfer and creation of knowledge.....	14
4.2	Skills acquisition, development and training	15
4.3	Financial and physical resources.....	15
4.4	Organizational management.....	15
5.	Results and lessons learned from interviews.....	16
5.1	Innovation and development.....	16
5.2	Business model/plan/structure.....	17
5.3	Market and positioning.....	17
5.4	Marketing strategies	17
5.5	Intellectual property	19
5.6	Growth strategy	19
5.7	Management of the financial resource	19
5.8	Management of the human resource	20
5.9	Partnerships/International	20
5.10	Failure factors or obstacles to commercialization	21
6.	Conclusion	21
7.	Appendix.....	23
8.	References	23
	Catalogued publications	24

Report on interviews on the commercialization of innovation

1. Introduction

Is Canada suffering from the same science and technology syndrome that has struck Europe in recent years, known as the "European Paradox"? What is it?

The paradox could be formulated on the basis of the following question: why is Canada not gaining in personal wealth when public investments in R&D, highly qualified personnel and a science and technology educational infrastructure are strong? A proposed framework to explore the answers to this question focuses on linking inputs with outputs within a life cycle. Earl, Gault and Bordt (2004).

Neither the conversion of ideas into products nor a product's encounter with the marketplace is always successful. What are the factors and processes that favour success in this area? Many analysts believe that the key to this question lies in studying the process by which innovative products are commercialized.

The current statistical system does not systematically collect data on activities relating to the commercialization of new or significantly improved products.

Present surveys do not cover the private sector. Therefore while data on R&D performance are available, no information on the importance of public sector intellectual property, the extent of commercialization of R&D, the degree of inter-business licensing, the management of intellectual property or financing commercialization activities is collected. Earl, Gault and Bordt (2004).

With the advent of the new emerging markets of China, India, Brazil and Korea, opportunities and potential outlets for Canadian products are taking on an entirely new dimension. To some extent, the growth and wellbeing of Canada's population depend on our ability to commercialize our innovations on these markets and expand our trade horizons. The problem is not so much the international competition on these markets but rather our ability to trade in products for which Canada has a comparative advantage. That advantage also arises from being better able to manage the process of commercializing our most innovative products.

Today, Canada has a unique opportunity—to build, from our current economic strength, an enduring national advantage, and to excel in expanding the critical capacity to translate the ideas in our heads into products, processes and services in the market. Industry Canada (2006-a).

For sound management of the commercialization process, is it not first necessary to get a grasp of what the commercialization of innovation is, from the standpoint of the public and private sectors, including universities and other research institutions?

The main objective of this report is to give a picture of what the process of innovation commercialization is, based on a set of interviews conducted with respondents in the Canadian business sector.

The report is organized as follows: after presenting the background of the project and a rapid overview of the literature on the subject of innovation commercialization, various conceptual approaches and definitions regarding the commercialization process are presented. The next-to-last section proposes a conceptual and thematic framework that is preferred for describing the innovation commercialization process. Finally, the last section reports the main findings from the interviews.

2. Background of project

Research studies on commercialization are a consequence of earlier Statistics Canada research projects on R&D and innovation. These studies are also in the tradition of studies undertaken in the framework of the OECD to shed light on the innovation process.

Following three decades of research and coding of statistical practices in the R&D field, the 1990s saw the development of indicators, standards and conceptual frameworks for measuring innovation. While R&D measures investment in the development of new scientific and technical knowledge, innovation measures the characteristics of firms that have brought new or significantly improved products and processes onto the market in the last three years.

These two statistical approaches have successively examined knowledge creation and the development of products and processes, two aspects closely related to the scientific and technological aspects of technological progress. This initiative on commercialization focuses more on the organizational aspects, and it seeks to provide information that will help answer the following question: once a firm or organization has developed knowledge and a product or process, how does it go about generating economic benefits in terms of income, cost saving and strategic positioning?

By undertaking this study, we want to learn what activities are carried out by firms seeking to obtain commercial success for their innovations and R&D studies. This includes strategic positioning, financing, marketing activities, the protection of intellectual property and the role of partnerships.

The first stage of this project was to conduct a series of semi-structured interviews with company managers. The interview was intended to cover the range of factors and activities that positively or negatively affect commercialization. The interviews, lasting one hour, covered at least four themes related to commercialization. The semi-structured format also allowed groundbreaking aspects of commercialization to be explored.

The results of this series of interviews will provide valuable material for developing a new survey on the commercialization of innovation and R&D.

3. Concept, definitions and models for commercialization in science and technology

3.1 Definitions

3.1.1 Commercialization as defined by the Canadian panel of experts on commercialization¹

Commercialization refers to the series of activities undertaken by firms to transform knowledge and technology (whether developed in Canada or abroad) into new products, processes or services, in response to market opportunities. Highly skilled workers (researchers, engineers, managers, etc.) are critical to the commercialization process, as is a culture that values innovation and entrepreneurship.

3.1.2 Commercialization as defined by the Department of Fisheries and Oceans Canada

Commercial defines an operation that is dedicated to an activity that has been proven to be viable, meaning the elements or assumptions of the activity have been proven and can be modeled in a business plan. The objective and expectation of this stage are to create profit.

Commercialization is the process of turning an idea or invention into a useful product or service. Some view commercialization to mean turning an idea or invention into a marketable product or service that will return a profit. Commercialization is a component of the broader innovation process and can include trials or studies that make a financially viable operation more profitable.

3.1.3 Commercialization of innovations as defined by the Oslo Manual (2005)

A marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing (OECD, 2005: page 49).

Marketing innovations are aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales (OECD, 2005: page 49).

While the commercialization and innovation processes are interdependent, it is nevertheless necessary for purposes of comprehension to distinguish between them based on the following principle:

Commercialization has more to do with taking R&D from the lab to the stage where it can find application in an industrial setting. Actually using this know how to develop a new product would be innovation (Cornford, 2002).

1. In May 2005, the Minister of Industry appointed a six-member non-partisan expert panel on commercialization to identify how the Government of Canada could help ensure continual improvement of Canada's commercialization performance. Industry Canada (2006-b).

3.2 Models

3.2.1 Chronological and linear approach

3.2.1.1 Model of H. Randall Goldsmith²

Randall Goldsmith's commercialization model is a road map of strategies and actions for the commercialization of advanced technologies. The model breaks down into twelve activities that describe the process to maximize the chances for success. Each sequence has a technical stage, a market stage and a business stage.

The model is a framework for measuring progress in the different stages, namely identification of information and technical assistance needs, project development costs and the forecasting of financing requirements. It follows a quite specific, ordered process (see matrix diagram below).

Concept phase		Development phase	Market entry phase	Market expansion phase
Market	Initial market and opportunity assessment Lead customer identification and engagement	Develop marketing plan including segmentation, channel and customer relationship strategies	Implement promotion plan Perform competitive market intelligence	Target vertical and adjacent markets and increase market penetration Enhance partnership delivery channel and CRM
Business	Identify financial, physical & HR requirements	Secure required financing Establish management team, financial and business plans Determine break-even point	Manage financing, skills and production needs Adjust strategic and business plans to respond to market opportunities	Diversify internal and outsourced skills required to meet ROI objectives Establish international partnerships
Technical	Determine features and performance requirements Perform competitive technology intelligence – Patent search	Move development into prototyping, testing and production phase Source raw materials and establish Q&A systems	Establish manufacturing facilities and product technical support	Determine incremental product development cycle Continuously assess competitive product functionality and emerging technologies for adoption

Source: Based on Dr. Randy Goldsmith, Oklahoma Technology Commercialization Centre with modifications by Acorn Growth Companies.

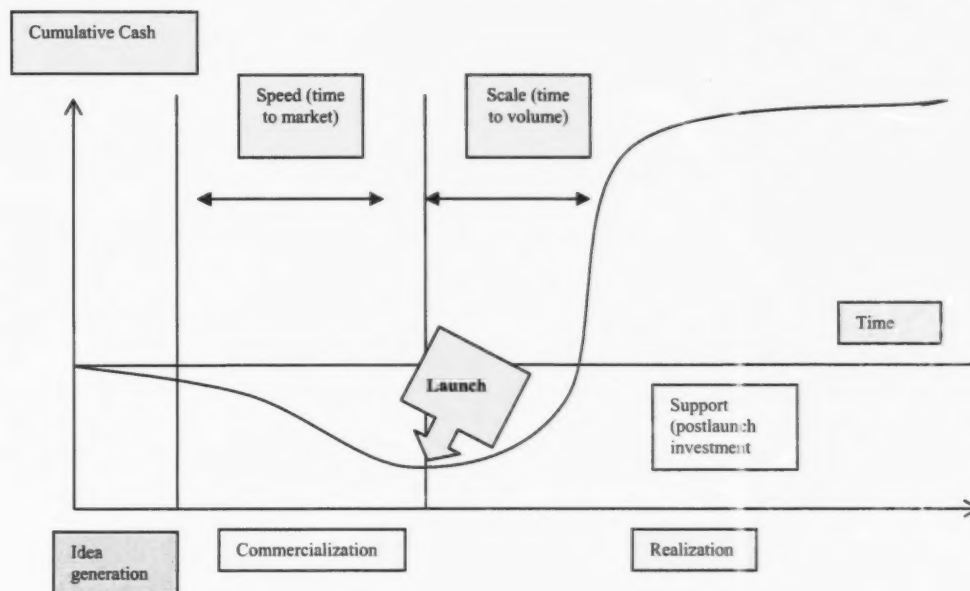
The Goldsmith's model was designed to provide a mechanism for commercializing new products and processes (totally new ideas). This framework is not suited to commercialization for technology adoption purposes (incremental innovation). "The Goldsmith framework was designed for new product introduction and new company creation which is most often reflective of emerging and disruptive technologies. These emerging and disruptive technologies account for a very small percentage of total innovation where the majority of innovations involve adopting or adapting technologies." Earl et al. (2004).

A deficiency of the Goldsmith model is its lack of flexibility regarding feedback, since it is linear by nature. For example, in the case of technology adoption, it is not essential to go through the development phase, yet this model does not lend itself to interchanging the sequences in accordance with operational requirements or the stage of development of the product. For this purpose, the functional models (described further on in this section) seem more suitable.

2. Dr. H. Randall Goldsmith developed a conceptual framework for the process of commercializing advanced technologies; website source: Arkansas Economic Acceleration Foundation; aeac.arcapital.com/technology_commercialization.

3.2.1.2 Commercialization model of James Andrew and Andrew Sirkin

As in the preceding model, the diagram representative of Andrew and Sirkin, below, shows a series of sequences in the commercialization process. In the two initial phases corresponding to idea generation (research and development, conferences, etc.) and commercialization, investment in the project is deficient (cumulative cash). In this model, the transition period between these first two phases is decisive for profitability and successful marketing.

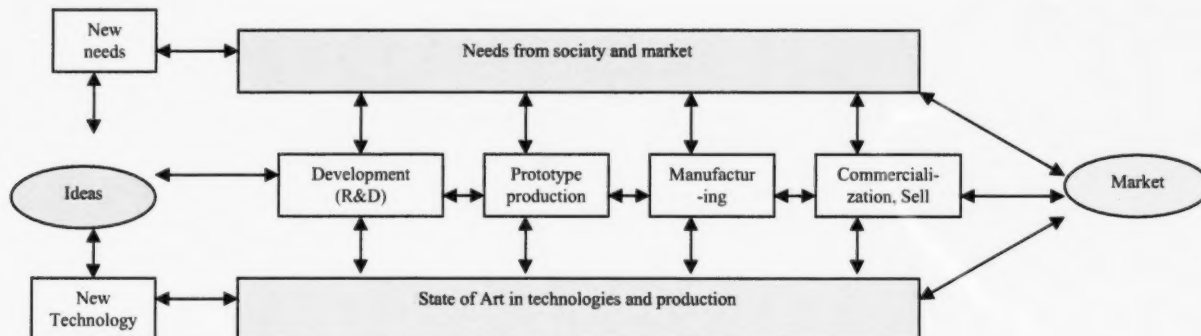


After the product is brought onto the market, the time to volume corresponds to the time needed to reach a profitability threshold. The sooner the product or service reaches the optimal production scale, the more quickly it will be able to generate profits, and it is the market response that will determine commercial success or failure.

The third phase (realization) puts the emphasis on the profitability of investments. This profitability is not always achieved, since the costs of technical support, advertising and development may exceed returns on investment. Nevertheless, such a situation may be tolerated in order to derive indirect benefits from it through the exploitation of intellectual property rights via royalties on patents, copyrights, etc. In other words, commercial success can also be measured by this type of indirect benefits.

3.2.1.3 The technological innovation and commercialization model of Rothwell and Zegveld

The model of Rothwell and Zegveld (1985) shows that commercialization is an integral component of the innovation process. The heart of this model lies in the interaction of its components. According to this approach, it is the combination of market needs (market pull) and technological opportunities (market push) that gives rise to innovation. Like Goldsmith's model, this model is sequential, but it allows feedback between components.



Source: Rothwell et Zegveld, 1985.

The R&D and commercialization components interact to create technological opportunities and satisfy the demands of the market. Chiesa (2005) notes that linear models prevailed during the 1960s until the early 1970s; from then until the mid-1980s, it was linear models with feedback, called interaction and linkage models, that dominated.

Gradually, from the 1990s to the present, models emphasizing the sequential process of innovation and commercialization have given way to models in which function takes precedence over linearity. In this generation of models, the R&D, commercialization and financing functions interact in no particular order. Throughout this process, suppliers and customers, upstream and downstream in the process, provide continual feedback on the functions. This type of model also assigns a greater role to horizontal (external) partnerships.

3.2.2 Functional approach

From the standpoint of the firm, commercialization is an integral part of the innovation process and may be described as putting in place a set of conditions and elements or activities that the firm must necessarily fulfil in order to generate income from goods or services innovations introduced respectively in the marketplace and in the production system.

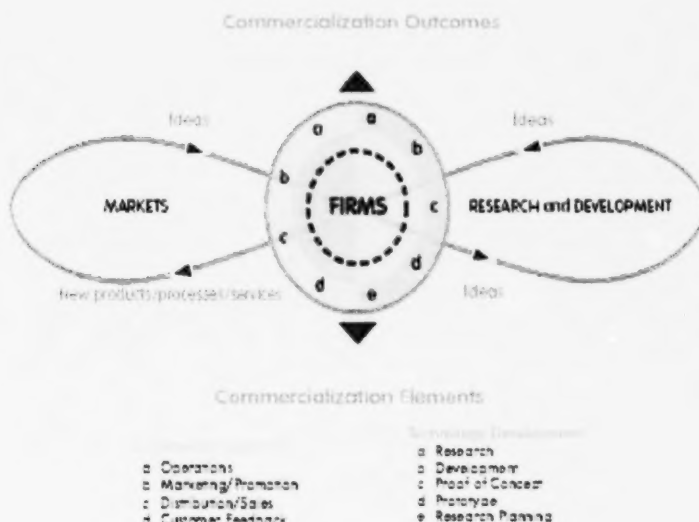
Under this so-called functional approach, the firm is not obliged to manage the commercialization process according to very specific sequences in chronological order. This approach tackles the commercialization process on the basis of activities and functions on which the customer or the firm can act and provide feedback continuously, regardless of the stage in the commercialization process.

This vision of the commercialization process offers the firm a flexible framework in which to manoeuvre, one that does not entail a chronological path where feedback would be more problematic. It serves to spell out the functions specific to the commercialization process according to the firm's needs, in an order specific to it.

Thus, the firm may decide in its commercial strategy to develop the business partnership before the design stage. The firm may also think about its financial needs and at the same time, develop its organizational strategy for acquiring R&D.

The reality of Canadian firms is quite different depending on whether the firm is small or multinational in scope, or whether it is in the biotechnology field or in retail sales. The commercialization process is an overlapping of complex functions which are not all necessary for each firm but which instead depend on the specific characteristics and needs of the firm. It therefore seems important for this process not to be set in stone; instead, it should be formulated in such a way as to fit the reality of each firm with its individual differences.

The model below (an adaptation of the model developed by the Canadian Expert Panel on Commercialization) is designed to present the different functions of the commercialization process in a non-temporal framework including all elements necessary to commercialization that firms may adopt on the basis of their individual needs.



Sources: People and Excellence volume II, Industry Canada (2006-b).

In the above diagram, it is immediately obvious that ideas are central to the commercialization process. These ideas are conveyed by all the participants in the process, including the customer and the supplier, who may at any time interact and incorporate new elements.

New ideas that generate innovation can arise at any stage in the commercialization process, be it the development (R&D) stage or after the product is brought onto the market. Goods and services that reach the market are subject to the law of supply and demand, and they therefore adapt and continue to evolve. The evolution of the product once it is on the market is thus an element in the commercialization process where, for example, the service and customer support function comes into play.

The commercial and technological development functions are completely integrated and are articulated within the firm. To these functions, it is appropriate to add elements or activities that are essential to the commercialization process. The model proposed by the Canadian Expert Panel on Commercialization identifies the following elements:

- Financing
- Skills and human resources
- The global perspective
- Intellectual property
- Regulatory environment
- Partnering and collaboration

Finally, this commercialization model affects the following outcomes:

- Standard of living and quality of life
- Economic growth
- Competitive advantage
- Productivity
- Market success
- Innovation

4. Other concepts and themes related to commercialization in science and technology

The previous section described the current state of the main conceptual models on the commercialization process and how they have evolved. It was noted that there are essentially two approaches: the linear or chronological approach and the functional approach.

These models have in common a number of elements that a firm must implement in order to manage effectively the commercialization process as defined in the section on design, definitions and models for commercialization. The main differences between the models lie in the choice of elements to be included in the process and the order in which they are applied. On these principles, the scientific community has not yet reached a consensus.

In this report, a number of choices were made in order to shed as much light as possible on the commercialization process in the context of science and technology. To this end, we extracted what was essential in the current knowledge on this subject for the sole purpose of formulating a conceptual framework on the commercialization process so as to be able to mark out the constituent elements of that process and improve our understanding of it.

The choice of the constituent elements of the conceptual framework for the commercialization process proposed here is not definitive, but could be useful for thinking about the approach to follow in future studies.

A non-exhaustive list of elements and activities that a firm should control and integrate into its commercialization process

4.1 Transfer and creation of knowledge

- Knowledge of scientific principles behind the invention/idea
(Define concepts, estimate critical obstacles to production, determine assumptions relating to performance, and identify materials)

- Knowledge of market conditions for inputs and outputs
(Feasibility studies, estimation of amounts and prices, demand)
- Knowledge of legal and legislative framework for finances and management
(Develop financial plan, master tax concepts and standards)

4.2 Skills acquisition, development and training

- To go from the scientific discovery stage to the concept
(Trials of prototypes and engineers' test, quality testing, improvement of the process)
- To manage intellectual property
(Patents, trademark, copyrights, confidentiality agreements, secrecy, complexity of development, royalties)
- To control the growth process
(Advertising, technical and commercial support, dissemination, outsourcing, sub-contracting)
- To develop access to the market
(Product launch publicity campaign, market niche, competition, market segmentation, competitiveness and comparative advantage, exports, search for new markets, distribution channels)

4.3 Financial and physical resources

- Identify and find the financial capital required for the commercialization process
(Subsidy and tax credits, sharing of financial risks, investment, other initiatives and financial incentives, direct financing of R&D, IRAP, regional incentives)
- Identify and find human resources, physical capital, inputs required
(Recruitment, training, capital assets, qualified personnel, competence)

4.4 Organizational management

- Identify potential customers and suppliers. Suppliers and customers include other firms, non-profit organizations such as universities, government organizations and hospitals
(Choice of partnership and partnership formula, horizontal ties, integration of suppliers and customers into the process, centralization or decentralization of technological functions)
- Identify and apply own business management model to manage the commercialization process effectively
(Business plan, enterprise structure, manual of sales and customer service procedures, follow-through, value-added, timing, leader or follower strategy)
- Choose the strategy or strategic combination for technology acquisition
(intra vs. extramural, identify emerging technologies)
- Identify obstacles to commercialization
(Cost and financing, market outlets/competition, market dominated by established firms, uncertainties related to demand, lack of knowledge of the market, lack of market standards/regulations, products poorly received by consumers, weak distribution system, etc.)

5. Results and lessons learned from interviews

During 2006-2007, Statistics Canada conducted a series of interviews, primarily with commercial firms in the private sector but also with universities, federal laboratories and other institutions. The interview process targeted all economic units that produce and commercialize products. Firms were selected randomly from several existing sampling frames, namely those from the Survey of Research and Development in Canadian Industry, the Technology Use and Development Survey, and the Survey of Innovation, 2003 and 2005. The firms selected are small and medium-size firms or enterprises (SMEs) with fewer than 500 employees. Most of the time, the interviews were conducted on-site with a senior officer or management supervisor. When it was not possible to travel to the location, the interview was conducted by teleconferencing. Firms interviewed were located in Vancouver, Halifax, Winnipeg, Toronto, Ottawa and Montreal, for a total of approximately 40 interviews. The questionnaires were designed for interviews averaging an hour in length, but some interviews were spread over more than three hours with respondents' agreement and engagement.

This series of interviews was designed to collect information on various essential aspects of the innovation commercialization process, including knowledge of the market, management of intellectual property, pre-commercial activities, etc.

Based on a tabulation of the information collected, the next section describes highlights, observations and lessons learned from respondents' various experiences with commercialization.

The observations collected were grouped into themes for ease of reading and so that these themes can be related to the elements and activities described in the previous section. We have chosen to group the comments and remarks under common themes frequently brought up by respondents during the interviews. The information reported below is based on respondents' comments and interpretations, sometimes reported anecdotally.

5.1 Innovation and development

Many respondents reported performing research and development on an ongoing basis. Firms were generally found to devote the equivalent of 5% to 10% of their sales to R&D. Fairly consistently, very close collaboration is observed between the customer and the firm that develops the good or service. Regularly, the demand for innovation to meet a new need originates from the customer rather than the firm itself. For the firm carrying out such a project, the risk of failure in commercialization is high, owing to the fact that there is sometimes only one customer and that customer is demanding and knowledgeable. In other words, the customer, which is sometimes the only customer, demands innovation for its own needs, without concerning itself with the market for the product or service to other users. It is up to the performer to deal with this problem, to determine how to go from an innovation tailor-made for one customer to a general innovation that affects all the firm's products.

Research is often carried out at the start of the pre-commercial phase. It includes the testing, simulation and trial stages. Sometimes, this stage extends throughout the commercialization process. For example, aquaculture studies require continual adaptation of products and services since the project environment is subject to frequent changes, with respect to both climatic conditions and the biological period in which fish reproduce, and consequently research is performed continually so that products can be adapted to these different cycles.

For some respondents, research and development may continue for sometimes up to ten years. This is the case with firms that are developing a single product that will be their lead product. Generally, small firms do not seem to have problems securing financing during the initial research stage. Respondents often stated that they were well supported and sustained by funds and government assistance. The assistance is not only financial; it also takes the form of research partnerships between universities and industry, which are the fundamental support for R&D.

On the other hand, during the development and pre-commercial phase, some respondents complain of a lack of support; they sometimes speak of a void with respect to development assistance. It was observed that small firms that develop products over a span of several years seem to be especially subject to this lack of support during the pre-commercial phase.

5.2 Business model/plan/structure

In general, it was found that large firms appear to have a well-established business structure and business plan. By contrast, small firms rarely do. A reason often cited is that it is easier for the firm to adapt to demand and the vagaries of the marketplace when it does not have a pre-established structural or business framework. Small firms prefer to adjust to customers' particular needs or respond to market conditions. They do not have the means to set up a plan or structure in advance.

Medium-size firms or institutions generally have a well-established structure, with an advisory board, a board of directors and an agenda including directives for the coming years. This framework is adjustable and regularly reviewed. Some firms even have a whole division in charge of the planning of both routine operations and commercialization. Sometimes, the mandate of the advisory board is dictated by customers who may themselves sit on this board.

Having a business plan for commercialization, even for larger firms, is not always practical, since such plans are often established for one- to five-year periods. Some products are commercialized over a much shorter period, and the business plan must be able to adjust; otherwise, it is of no use. To overcome these timing differences between the planning objectives (business plan) and the innovation cycle, firms that can do so sometimes establish two or even three business scenarios for different periods (one year, two to three years and five years).

5.3 Market and positioning

It clearly appeared that almost all respondents are quite knowledgeable about their economic environment. They easily manage to identify the direct competition as well as the type of product offered by their competitors. Nevertheless, the main competitors are on the Canadian market, even though the firms commercialize their products or services throughout the world. Only rarely did respondents identify their main competitor as being a firm outside Canada.

Respondents often reported having a commercial niche with respect to the main innovative product that they were commercializing or attempting to commercialize. For these firms, there is no direct pressure from competition; their innovation creates their market positioning.

To make themselves known, firms publicize themselves at conferences or advertise in magazines or journals to attract potential customers. They all strive to maintain their address book (up-to-date customer list).

Some respondents who have not yet commercialized their products target both the local and the global market. But when they target the global market, the question of intellectual property becomes crucial, and the performer precisely targets markets in which it wants to issue patents or licences.

For small firms, word of mouth is often cited as the main method that they use to make themselves known. Larger firms more readily turn to creating a website to promote their products and know-how.

Strategic positioning is closely tied to the marketing strategy. For example, firms compete extensively on the price and the quality of their products; these are two characteristics that influence both the firm's positioning and the marketing strategy itself. Some respondents reported that their pricing policy was their sole strategy for positioning themselves and commercializing their products.

5.4 Marketing strategies

Firms commonly use the Internet to commercialize and promote their products. Those that do not yet have a website said that they intended to create one as soon as possible.

Larger respondents (with sixty or more employees) tend to have their own commercialization division or team. However, integrating the commercialization team is not without its problems. Respondents complain that

commercialization personnel not trained in engineering sometimes have difficulty promoting highly technical products. In other words, if a firm wishes to acquire its own commercialization team, it must have a strategy for integrating the commercialization group and the development group. Such co-operation is indispensable if sales operations are to function smoothly; otherwise, it is hard to convince the customer that the product is the most competitive on the market.

Small and medium-size firms favour flexibility as a strategy so as to ward off unpleasant surprises when it comes to commercialization. A firm may have undertaken major efforts to develop a product over a period of years and when this product comes onto the market, the main customer may have changed direction completely or disappeared (having gone to set up operations in another country), or the market itself no longer exists and the demand is no longer there, as the existing technology has been replaced by another one. It is therefore important for a firm not only to know its market well but also to prudently manage its address book (customer list) and the confidence that it has built up. Commercialization also entails learning the best method of negotiation and absorbing the lessons from past commercialization efforts that were unsuccessful. In some cases, the loss of a market enabled the firm to revise its way of making contracts and managing its customers' confidence.

SMEs sometimes rely on the mere fact of being in a segment of the market in which competition is weak. In this situation, they have established very close ties with a few customers who, by default, regularly do business with the performer. The latter, knowing its competitors well, merely sends a few subcontracts their way in order to keep the market under its control.

When SMEs are faced with more substantial competition, their main strategy is to get the product onto the market quickly (to be the first). To do so, they sometimes choose to market the product immediately, without going through beta or test versions. Of course, the product will not be perfect, but to capture the market, the performer prefers to make corrections to the product after it is marketed in order to keep the customer. This strategy is sometimes used with the complicity of the customer, who prefers to give his advice on the improvements to be made based on his own experience.

By contrast, some firms find it essential to go through all the testing and trial stages before marketing, since their structure lacks flexibility and does not lend itself to going back for technical adjustment of the product and adjustment of the production line itself.

Some firms seem to take it for granted that they will not in any case have sufficient means to commercialize their innovation. Their only strategy is product development, after which they try to sell the firm and the ownership rights to the innovation to a larger firm that will take on the task of commercializing it.

Company incubators have found that institutions that develop their products in isolation—that is, without partnering with industry—have much more difficulty commercializing those products.

Management of the timing for introducing a new product (a good or service) is considered a major problem in commercialization. The timing chosen may be in response to the strategy of competitors who may introduce their products at the same time, but it may also be based on the firm's existing products: introducing a new product may erode the profits on older products that the new product makes obsolete. This phenomenon, known as cannibalization, can seriously reduce the firm's expected profits. Also, as noted above, if a product is brought onto the market too late, this can nullify all development efforts. To avoid these pitfalls, where possible, firms study the market (conditions, competitive environment, demand) in advance.

The marketing of an incomplete version of a product (software) at a low price can serve to attract customers, secure their loyalty and lead them to purchase the complete version. This method allows the firm to keep the source codes without exposing the final product to competition.

5.5 Intellectual property

For legal issues relating to intellectual property, most interviewed firms reported using a law firm or other expert services to manage and provide advice on this matter.

Generally, for firms whose positioning represents a market niche and there is little competition, respondents do not see the need to file patents or take any measure to protect ownership of intellectual property. In this type of environment, the players know each other.

In the computer field, firms seem to prefer seeking protection in, say, the complexity of the product or not giving access to the source codes of a software product, for example. These firms grant their own user licences, which gives them better control over users/customers.

When firms use patents, they do not do this systematically for all products, since patents are costly and administering this type of protection (obtaining certification) is a lengthy process. Small SMEs sometimes do not file any protection; their explanation for this is that they do not have the means to defend themselves in court.

Sometimes respondents do not participate in conferences or fairs so as not to show their innovations. They prefer to concentrate on development and then sell the ownership rights to larger firms.

For highly specialized products that require rare raw materials, patenting the product at the international level is done according to specific criteria. For example, the firm may identify places that produce the raw material that is indispensable to the product, since it is in these places that the product can be reproduced. Patents are therefore targeted according to specific characteristics of the market. On the other hand, a number of respondents consider it pointless to protect products on the Chinese market, since they believe that the protection provided is insufficient or non-existent.

Granting licences was never cited as a corporate strategy for protecting intellectual property, although some respondents grant licences to small businesses.

5.6 Growth strategy

Few respondents reported that they followed a well-defined growth strategy. Sometimes the only strategy was simply to be the leader in the market, and for this, the firm seeks a niche for the product where there is little competition. When the competition is greater, selling at the lowest price seems to be the rule.

Seeking out new markets is done more readily in the more formal structures, and sometimes it is done collaboratively. These firms have easier access to a marketing team that does promotion in new markets. In this case, a better sales force gives the advantage to the product, which benefits from it.

5.7 Management of the financial resource

The great majority of respondents report that they finance research and the commercialization process by their own means. But they also acknowledge resorting to R&D tax credits, grants and other government programs. These programs are considered useful in the initial development stages for these products.

The banks are little used as a means of obtaining credit for SMEs, since they require far too many guarantees and want a quick return on investment. Venture capital firms are cited more often. However, the venture capital market differs from one province to another. This market is limited, and respondents sometimes doubt that venture capital firms are well-managed. Furthermore, venture capital firms are subject to frequent changes related to political conditions, and for SMEs, the resulting uncertainty creates a climate of insecurity.

Some respondents suggest a two-tier financing system, with one level for SMEs and the other for large firms that have more equity. Others say that there should be tax credits for commercialization.

5.8 Management of the human resource

SMEs use all sorts of ways of attracting and retaining the personnel that they need. This ranges from simple word of mouth to direct recruitment on the campuses of universities and other educational institutions and the use of headhunters. In some fields, the search for personnel is not a problem, since specialized training exists; this is often the case in the computer science field. By contrast, in other cases specialized personnel are quite rare. Providing in-house training is then the only way to secure competent personnel. Also, firms often spend sizable amounts contracting private training for their personnel to keep them interested and motivated. In-house training becomes crucial for specializations in which the personnel achieve maturity only after many years of practice. The transfer of knowledge and expertise becomes a condition of survival for such firms.

It was often mentioned that the nature of the work and the interest that it holds, especially in scientific fields, is a major factor in retaining competent personnel. It should be kept in mind that in the case of small SMEs, it is sometimes a matter of projects and ideas that come from one or two persons, and it is on this basis that the firm has built itself. In such a case, the firm's reputation becomes an important characteristic for attracting the most qualified and competent personnel.

To retain qualified personnel, in many cases with qualifications that are rare, firms offer competitive wages and sometimes options or shares in the firm or bonuses. The smallest firms have few means to give specific training to their employees. By contrast, the largest structures often provide such benefits. Large firms also provide employees with relocation assistance, along with the opportunity to participate in conferences, symposiums and other professional gatherings.

Partnering with universities and public institutions is sometimes a very good way to bring in new personnel. SMEs that receive government assistance delegate part of their research to universities. Graduating students who have participated in such projects are a good pool of potential candidates for the partnering firm. It is in this context that some firms participate in student co-op programs and offer practicums.

To retain personnel, offering employees the option of telecommuting is a practice that is still rare but is becoming more common, especially in the case of remotely located firms that find it especially difficult to attract employees to the area. Drawing on professional associations is sometimes another good alternative for finding personnel.

5.9 Partnerships/International

Some firms opt for partnering to commercialize their products. These co-operative relationships focus on a number of aspects of the commercialization process, from the development of an innovative technology to implementing a commercialization strategy. In seeking such partnerships, firms do not limit themselves to the private sector. Partnerships are widely arranged with the public sector, including universities and government research laboratories, in order to gain expertise that complements internal know-how.

Partnership with the public sector appears to focus more on the technological component of commercialization, since small firms often report that they lack the human resources and equipment to conduct their own research programs. Other firms use government facilities and buildings to test products and demonstrate their effectiveness. Still other firms turn to the government to benefit from its research expertise. What begins as co-operation with a university in order to have access to researchers may subsequently shift more toward a partnership for the commercialization of innovative products or the sharing of ownership rights. The firm must measure the risk before considering such co-operation. Often the firm comes up with the idea but turns to university students to develop it.

Forms of partnerships in the private sector tend to be more varied than in the public sector. When a small firm does not have the scientific expertise needed for commercialization, it may choose to partner with another small firm so as to pool their fields of expertise and knowledge. In extreme cases, the firm partners with its direct competitor.

In attempting to bring a product onto the market, small SMEs may sometimes attract the attention of larger firms, who may then enter into an agreement to simply commercialize the innovation. This form of co-operation gives the

financial benefit to the large firm and an increased guarantee of success in promoting the product to the small firm, which benefits from the reputation and credibility of the firm that was already well established in the market.

5.10 Failure factors or obstacles to commercialization

Two obstacles invariably come up as being the most important: the lack of financial means/support, and specialized personnel, especially personnel used to selling and promoting innovative products (good technical knowledge is required). For many SMEs, the ideal situation would be to have personnel who are able both to develop the product and to sell and promote it. Some respondents were even forced to collaborate with competitors to have access to the necessary personnel; otherwise they would have been forced to abandon the project.

The products developed are usually successful from a technical standpoint, but it was the commercialization stage that sometimes failed, mainly owing to the lack of human resources qualified to promote the products. Small firms sometimes resign themselves to being purchased by larger firms that have the means to commercialize innovation, since they more often have a "marketing" team.

Respondents note that financial and technical support by public institutions in the initial stages of development is well established and commensurate with needs. But in the subsequent stages of development and commercialization, respondents speak of a void in financial assistance from government. And yet, support in these stages is crucial, since it is then that the product is being commercialized and investors are hoping for a return on capital.

Because consumer preferences change quickly, it is difficult to allow the time needed for innovation. Market demand changes faster than the time needed to develop the product. Fierce competition and changing consumer preferences force firms to innovate or improve their products constantly.

It is suggested that the demand from industry is somewhat conservative and that a product can take ten years before it satisfies demand and is accepted by the market.

Resistant attitudes, both in industry and among consumers, are sometimes a real obstacle to commercialization. Along similar lines, some respondents state that in seeking a partner to commercialize the product, it is difficult to find one that has the same business philosophy as the firm that developed the product.

The red tape involved in conforming to the rules of the market is perceived by SMEs as an obstacle, especially when time and resources must be set aside for translating all documents. The time required to obtain compliance authorizations is sometimes too long and can cause the market to be lost to competitors.

Access to information is a problem when it comes to choosing the method of commercialization. Firms hesitate between investing in a website to promote products and merely placing traditional ads in magazines or using a number of methods at once. There is a lack of accessible information on the strengths and weaknesses (price, speed of dissemination, ease of reaching the target market, etc.) for each of these commercial strategies.

6. Conclusion

For years, Statistics Canada has used surveys to collect information on innovation, research and development and, more generally, science and technology. However, no major study at the national level has been conducted to determine the ability of Canadian firms to commercialize and the effort that they devote to this activity. The fact is that not all new ideas inevitably find their way onto the market.

For some firms, commercialization is an integral, rather than a separate, stage of the goods and services innovation process. For others, commercialization is instead a completely separate process for which it is necessary to plan a strategy before and after the product is introduced onto the market.

This report was written with a view to shedding light on the concept of commercialization as described and perceived by firms. The information was collected directly from a number of semi-structured interviews. The information

gathered was assembled in such a way as to bring out not only highlights but also themes that could eventually serve as a starting point for a survey designed to gain an understanding of the innovation commercialization process.

This report revealed that there are several possible approaches to describing the commercialization process. The traditional models follow a chronological procedure in which each stage must be completed before going on to the next. However, according to respondents, this model lacks flexibility and is ill suited to small firms, which prefer a more modular or functional approach in which the stages of the commercialization procedure do not necessarily follow one another in chronological order or in a matrix format.

To respond to this need, this report proposed a conceptual framework for the commercialization procedure, where basically certain elements and activities must be mastered in order to commercialize new ideas. The functional elements to be mastered include the transfer and creation of knowledge; skills acquisition; development and training; financial and physical resources; and organizational management.

From the interviews, it emerged that small to medium-size businesses (SMEs) seldom have the means to follow a well-established, formal and strategic procedure for commercializing new ideas. By contrast, large firms have the financial means and the specialized personnel to follow a formal procedure for commercializing products.

The methods and activities that firms engage in to commercialize their innovations and research depend on their strategic positioning. This ranges from merely "effectively meeting the customer's expectations" to more complex strategies such as "building a partnership network to provide comprehensive solutions", and "using strategies tailored to different types of clientele."

The protection of intellectual property is recognized as an important aspect, but SMEs do not always have the financial means to acquire it. Often, the one and only protection strategy is for the firm to develop and maintain a market niche (a unique product, with no competitors). When firms file patents, they do not do so consistently for all products, since patents are costly and time-consuming to manage and sometimes have little deterrent effect in the marketplace.

The most often-cited obstacles to commercialization are the lack of financial support in the post-development phases and the difficulty finding personnel specialized in sales who are also sufficiently competent to promote complex products.

Finally, the accounts of interviews showed that sometimes failures are a necessary evil, causing firms to grow and learn regarding commercialization. Some firms became aware of the importance of managing the commercialization process, including customer relations, after losing the market because they did not sufficiently study demand.

7. Appendix

For further information about the interviewer guide, please click on the link below:

http://www.statcan.ca/francais/sdds/instrument/5140_Q1_V1_E.pdf

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88-001-X Volume 30 – 2006

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